

# APPENDIX A

# POLYMERIC MATERIALS ENCYCLOPEDIA

Editor-in-Chief

JOSEPH C. SALAMONE

Professor Emeritus

University of Massachusetts, Lowell

VOLUME

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crushed in extruders and dried. In the process of crushing and drying the polymer, antisticking agents (e.g., glycine,  $\beta$ -alanine, polyethylene glycols, and fatty acids) and destruction stabilizers (e.g., 2-mercaptopbenzimidazol, phloroglucinol, and urea) are added. Easily storables and noncaking polymer gels may be obtained without drying by crushing the polymer gel in mills down to a particle size of 0.2–5 mm and coating the particles with a material poorly wetted by water, such as an active silicon acid, starch, or dextrose.

The polymerization of acrylamide in aqueous solutions in the presence of alkylating agents leads to the obtaining of partially hydrolyzed polyacrylamide. The polymerization process under the action of free radicals ( $R^*$ ) (formed upon initiator decomposition) in the presence of an  $\text{OH}^-$  ion formed upon the dissociation of an alkali addition (e.g.,  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{LiOEt}$ ) and catalyzing the hydrolysis can be described by Equation 2. The reactions II, III, and IV in the process are the main ones. With an increasing concentration of alkali the rate of polymerization increases and MW decreases. The nature of the hydrolyzing agent and the salt additions influences the acrylamide polymerization process.

#### Precipitation Polymerization

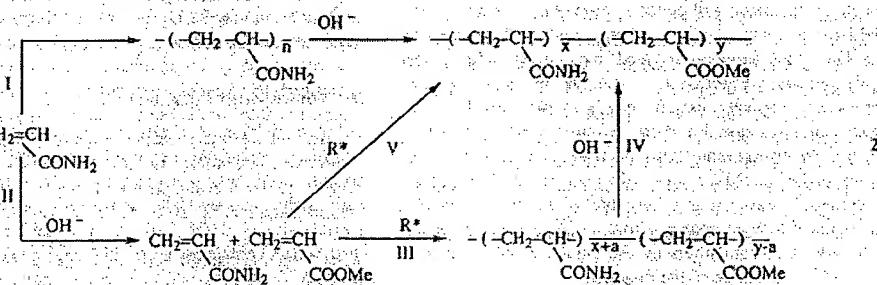
This type of polymerization of acrylamide is conducted in either organic solvents (e.g., acetone, acetonitrile, dioxane, ethanol, tert-butanol, and tetrahydrofuran) or aqueous organic media, which serve as solvents for monomers and as precipitates for polymers. For this reason, at the beginning of the polymerization the reaction mixture is homogeneous, whereas during the process, the precipitation of polymer takes place and the reaction proceeds under heterophase conditions. The commonly used initiators are persulfates, perborates, benzoyl peroxide, and AIBN. In precipitation polymerization the medium never gets very viscous and the polymer is relatively easy to isolate and dry.

The rate of acrylamide polymerization in an acetone-water mixture induced by  $\gamma$ -radiation from a  $^{60}\text{Co}$  source increases up to 20% as the water content increases, whereas MW grows up to 10% with the water content and then remains unchanged for water contents ranging from 30 to 70%. For the conversion degree above 20%, the formation of water-insoluble polymers has been observed due to the imidization. In the case of an acetone-water mixture containing 30–70% acetone, the polymerization is provided with the precipitation of flakes and the formation of coarse lumps is observed. To obtain stable dispersions and prevent the aggregation of flakes, salts are introduced to the reaction mixture. Highly water-soluble acrylamide polymers with  $\text{MW} = 6 \cdot 10^6$ – $10^7$  and high yields are obtained at 20–60 °C from 10–30% acrylamide. The precipitated polymer is filtered and dried.

#### Suspension Polymerization

The initial system is obtained by dispersion (in the form of droplets with diameters of 0.1–5.0 mm) of an aqueous monomer solution in an organic liquid by mechanical stirring in the presence of stabilizers. The dispersion medium may be represented by aromatic and aliphatic saturated hydrocarbons and by mixed hydrocarbons with  $C_6$ – $C_{10}$ . The polymerization is initiated by water-soluble initiators, UV and  $\gamma$ -radiation. The process occurs in droplets of an aqueous monomer solution acting as microreactors, and its kinetics resemble in some respects solution polymerization, although it is still affected by the stabilizers.

Depending on the hydrophilic-lipophile balance (HLB) of stabilizer, its distribution between aqueous and organic phases, and temperature, the polymerization in suspension may result in a complete phase separation and may occur either with or without the inversion of phases. The nature and concentration of stabilizer influence the rate of polymerization and MW.<sup>5,7</sup> The polymerization rate and MW in



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